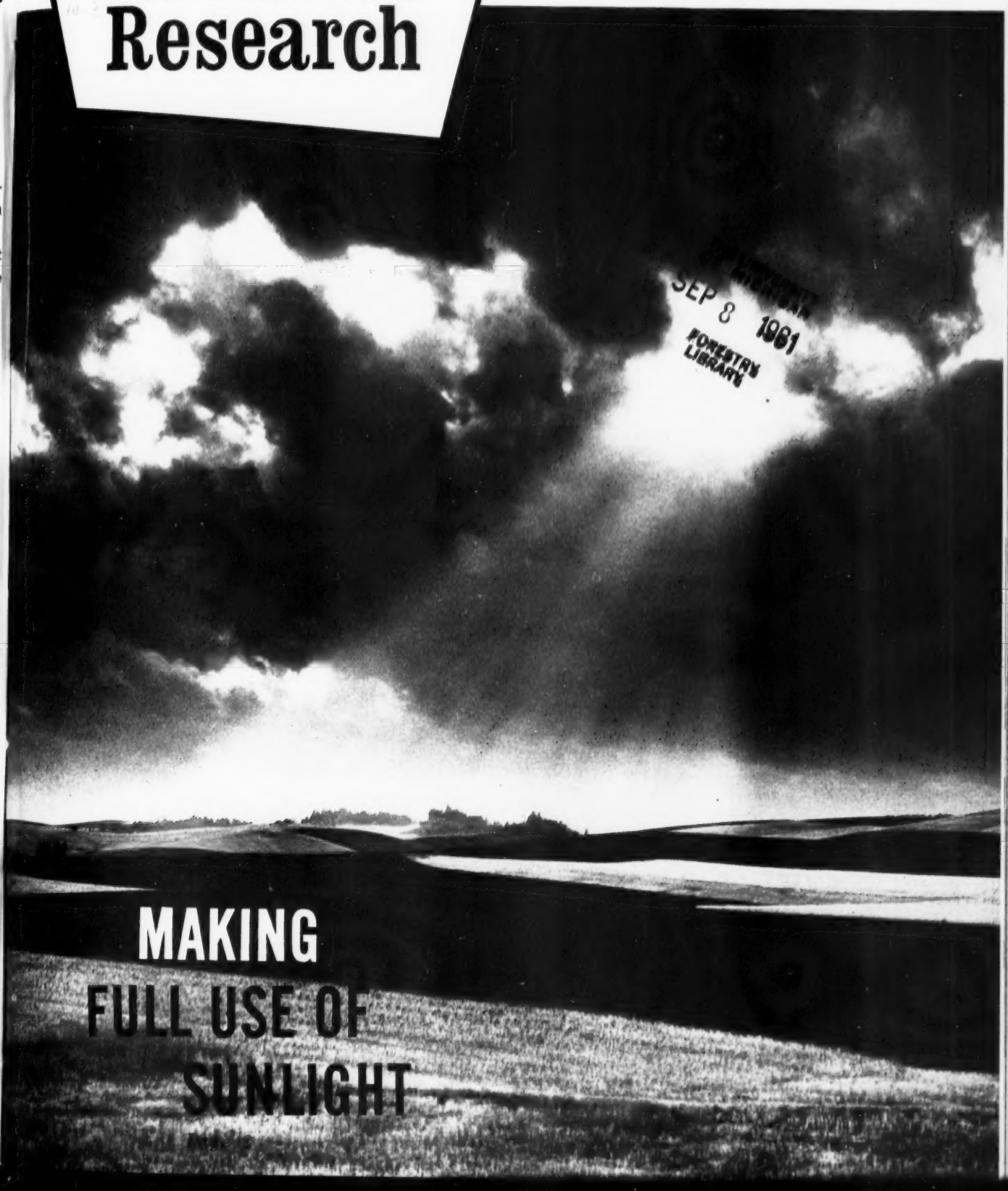
AGRICULTURAL
Research

U.S. Department of Agriculture/September 1961



MAKING FULL USE OF SUNLIGHT

AGRICULTURAL
Research

September 1961 | Volume 10, No. 3

Contents

Editor: H. G. Hass. Managing Editor: J. R. Madison. Contributors to this issue: S. S. English, B. R. Blankenship, C. E. Olsson, A. H. Miller, W. W. Martin.

For Consumers, Too

Few people realize how much of the effort going into agricultural research has the consumer as its chief beneficiary.

Fruit and vegetable breeders, for example, give high priority to research that assures good eating quality and high food value in the new varieties that are released year after year.

High standards of appearance, taste, and nutritive quality must be met before a variety is released to farmers.

Deciding if a new variety has superior quality depends on exacting tests that show how it satisfies the needs—or even the prejudices—of consumers.

Agricultural research goes beyond developing new food crops that pass these tests. A few years ago the fast-growing frozen food industry sought ARS help to get its products to consumers in top condition. Such help was vital because loss of quality means loss of consumer confidence and loss of sales.

This research revealed that all frozen foods have one characteristic in common: a limited tolerance to temperature fluctuations, making it essential to keep these products at 0° F. or below. This finding has been the basis of further work that is helping frozen foods maintain consumer acceptance. Such research provides consumers a wider choice, easier storage, and more built-in convenience in many processed foods.

Furthermore, consumers want fresh produce to stay tasty and attractive until used. Basic research showed that fruits and vegetables don't die when harvested. Respiration and other physiological changes that damage quality go right on.

Experiments with fresh produce held in various display cases and refrigerators revealed how equipment design and produce handling can be improved to maintain farm-fresh quality.

It's not enough that new varieties have improved plant characteristics that make them better for farmers. They must also have consumer-oriented characteristics—eye and taste appeal, high nutritive value, and adequate vitamin content.

In addition, new varieties must stand up to modern handling, storage, and shipment. And they must be adapted to home cooking as well as factory processing.

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington 25, D.C. Printing has been approved by the Bureau of the Budget, August 15, 1958. Yearly subscription rate is $1 in the U.S. and countries of the Postal Union, $1.50 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington 25, D.C.

AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

Big boosts in forage production may result because of basic ARS research on . . .

HOW TO MAKE FULL USE OF SUNLIGHT

■ We are nearer the time when farmers may fully utilize sunlight for big boosts in forage production. Many scientists think *management* of natural light—the only known growth factor that hasn't been intensively studied—may prove extremely important in getting higher forage yields.

To make light management practical, planting times and rates may have to be altered, harvest schedules changed, and plant varieties developed that make better use of light available during the growing season.

Much more must be learned about relationships between light and plant growth before the principles now being discovered can be put to work in the field. Nevertheless, recent findings supply the kind of information essential to future research—which may lead to practical light-use recommendations.

Experiments indicate that forage production may be limited either by light not reaching lower leaves in dense foliage, or by leaves not using all the light available in sparse foliage. By clipping and growth-rate studies in the laboratory, our agronomists are determining conditions that help plants make more efficient use of light.

Their work has already verified the importance of some recent leaf-area studies by British scientists.

The USDA studies are being conducted by C. W. Alexander and D. E. McCloud at the Agricultural Research Center, Beltsville, Md.

Their experiments confirm earlier findings showing that light of about 2,500 foot-candles intensity is required for maximum photosynthesis by a leaf. And light of about 300 foot-candles is needed for a leaf to maintain itself—that is, for photosynthesis to balance respiration.

Since normal sunlight intensity is about 10,000 foot-candles, enough natural light for maximum photosynthesis by a leaf occurs frequently. But in dense growth, lower leaves are shaded and often do not receive enough light. In sparse foliage, there are not enough leaves to efficiently use the light.

The researchers believe that these foliage-density factors ought to be considered when practical cutting and grazing decisions are being made.

Alexander and McCloud use an infrared gas analyzer to determine the growth rates of plant communities—some cut to certain heights, others grown at various densities.

The analyzer measures plants' rates of CO_2 uptake from air in a laboratory-controlled system. This approximates the rate of photosynthesis—or growth—of plants being studied.

Pearl millet grown to 36 inches had a 150 p.p.m. rate of CO_2 uptake—later considered low for this plot. When cut to 18 inches, its growth rate (CO_2 uptake) more than tripled (to 475 p.p.m.). This indicates the 36-inch growth had too much lower-leaf shading for most efficient light use.

Turn Page

602623°—61

HOW TO MAKE FULL USE OF SUNLIGHT

(Continued)

Cut to 12 inches, the forage had a low growth rate (CO_2 uptake)—only 200 p.p.m.—showing that too much leaf surface had been removed.

Varying the density of plants gave similar results. A community with 12 plants per square foot had a 375-p.p.m. rate of CO_2 uptake. Another with six plants per square foot had a high rate—500 p.p.m.; but one with four plants per square foot had a low rate of 300 p.p.m.

The scientists calculate Leaf Area Indexes (LAI), a measurement developed by British researchers, to study plots. An LAI defines the relationship (expressed as a ratio) between the surface area of the plants' leaves and the ground area beneath the plants. From this, a concept of the capacity of plant communities for using light has been developed.

Alexander and McCloud use this concept to estimate growth rates of plant communities in the laboratory.

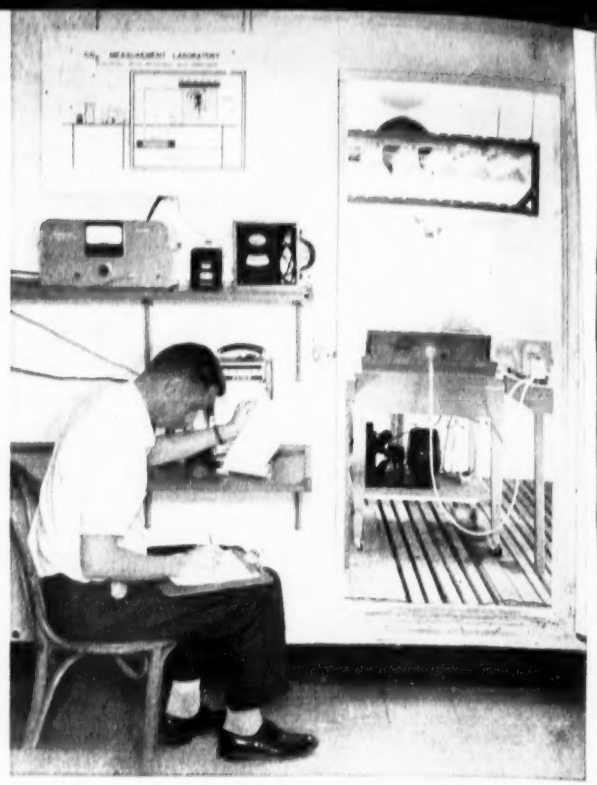
For example, they determine a plot's optimum LAI—when it most efficiently intercepts light—at its maximum rate of CO_2 uptake. This LAI might be used to indicate the conditions under which maximum growth rates can be expected in the field.

Such ideal LAI's, however, are valid only under controlled environmental conditions. LAI's for plants in a natural environment change continuously because of fluctuating light intensities throughout the day and varying rates of plant growth.

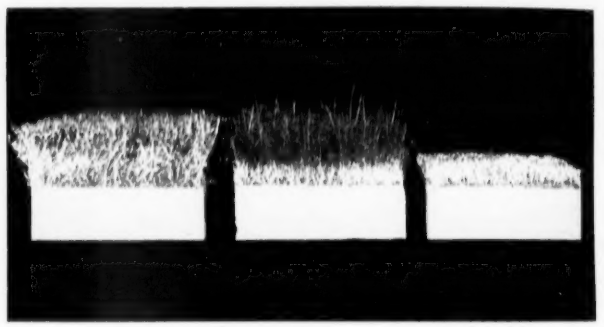
In future studies, the ARS agronomists hope to develop practical field uses for the basic principles they are developing.

Their studies of plant growth and light interception are the first to be made in the laboratory. Other scientists have made growth-rate studies in the field, where a full growing season is usually needed before meaningful results can be obtained. The laboratory experiments can often be completed in a week or two, and only a few minutes are required to measure a plant community's rate of growth by CO_2 uptake.

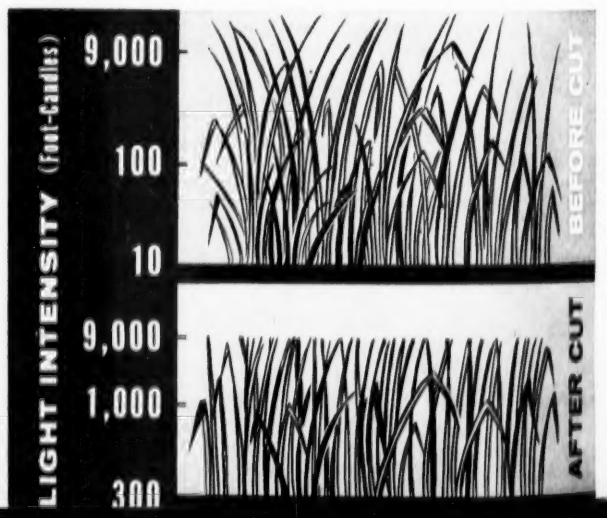
Plants in this research are exposed to various light intensities beneath a cluster of 300-watt photoflood lamps. They furnish light intensities up to 9,000 foot-candles, closely approximating sunlight.☆



Alexander checks CO_2 uptake rates of plants as they are illuminated by photoflood lamps.



Daily clip to 8 inches (left) kept lower leaves from adequate light. Plants (center) grown to 8, then cut to 2 inches (right), used light more efficiently.



Clipping affects intensity of light reaching lower leaves. Ideally, about 300 foot-candles of light intensity is needed for lowest leaves.

Wind, overgrazing, and dry weather often damage and cause considerable loss of this economical feed on millions of acres

Improving Grass Stands on the Southern Great Plains

■ How to get good grass stands on the Southern Great Plains is a question that desperately needs answering.

More than 6 million acres now in cultivation should be returned to perennial grass to protect the soil against wind erosion. Additional millions of acres of native range, damaged by overgrazing and periodic drought, need reseeding.

The area is generally dry and its summers are hot. Winds and rains cause serious erosion of exposed land. Because of high temperatures and evaporation following rain, the top layer of soil dries quickly and forms a crust. This is a major cause of grass-seeding failure, according to studies at USDA's Southwestern Great Plains Field Station, Bushland, Tex. ARS scientists there are working with the Texas Agricultural Experiment Station to develop more effective methods of establishing and maintaining good stands of forage.

Greenhouse tests indicate that adequate moisture for emergence of seedlings from a ½-inch depth cannot be maintained without irrigation or extremely favorable weather. If a medium amount (17 to 19 percent) of moisture can be maintained in the top ½-inch of soil, the speed and percentage of emergence can be increased by applying pressure to the soil surface or directly to the seed-band zone. Seedlings from 2- to 3-inch depths will emerge readily, if no soil-crusting rain occurs between planting and emergence.

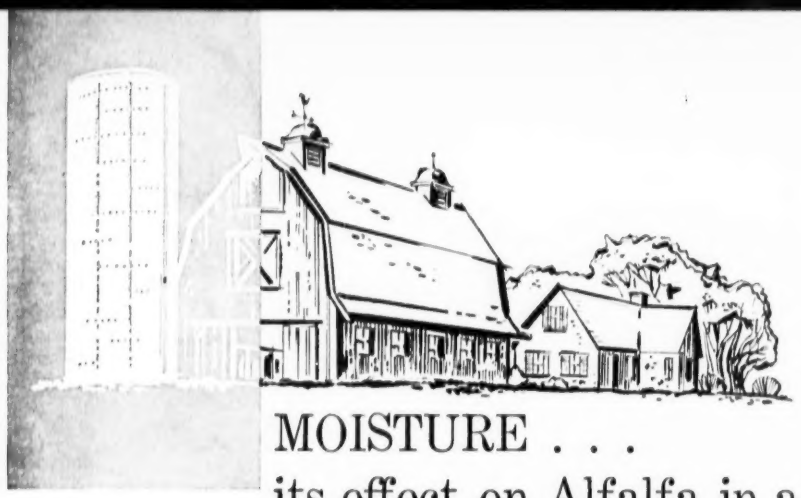
These results were obtained by agricultural engineer E. B. Hudspeth and soil scientist H. M. Taylor of ARS. They studied effects of planting depth, soil moisture, compaction, and crusting on seedling emergence. The tests were made with medium- to fine-textured hardland soil, common in much of the Great Plains. The test plant was Blackwell switchgrass, an improved, stem-rust resistant variety developed at the Kansas Agricultural Experiment Station.

Soil Moisture Highest emergence (67.5 percent) was obtained in soil with a medium (17 to 19 percent) amount of moisture. A 12-percent moisture content resulted in only 30-percent emergence. Stands were even poorer when soil moisture was higher than 19 percent.

Soil Compaction In soil with a medium amount of moisture in the ½-inch seed zone, emergence was increased by pressure applied either to the soil surface or to the seed-band zone. Pressure of 5 pounds per square inch applied to the soil surface was just as effective as higher pressures and sometimes more effective. Up to 10 p.s.i. applied directly to the seed-band zone increased seedling emergence.

Soil Crusting Surface crusting accompanied rapid drying of soil exposed to high temperatures after an irrigation that provided a 25-percent soil-moisture content. Seed was planted before irrigation. Emergence was less than 20 percent, and most seedlings came up through cracks in the crust. They were from seed planted no deeper than ½-inch. Seedlings planted deeper were unable to penetrate the crust.

Depth of Covering In soils having medium and low moisture contents, the surface layer dried too quickly for shallow-planted seed to germinate. Seedling emergence was greater from seed planted 2 to 3 inches deep when crusting was not a factor.☆



MOISTURE . . . its effect on Alfalfa in a GASTIGHT SILO

Stored as haylage, this forage made better feed than direct-cut silage

■ How does the moisture content of alfalfa stored in a gastight silo affect preservation efficiency, silage quality, and feeding value for dairy cattle?

USDA dairy scientists made a storage and feeding comparison between silages made from heavily wilted alfalfa (haylage) and direct-cut alfalfa. They found:

- Losses of preserved haylage (first-cutting alfalfa hay wilted to 44 percent dry matter) were half those of direct-cut alfalfa silage (11.1 percent of stored dry matter, in contrast with 22.6 percent).
- Forage ensiled as haylage had better quality than silage made from direct-cut alfalfa with 21 percent dry matter.
- Haylage was more acceptable to dairy cows than direct-cut silage. Milk production and body weight gains were higher on the haylage ration.

The smaller total storage loss of haylage was the result of no liquid loss and less gas loss than direct-cut silage, but somewhat more spoilage. Almost half of the loss from direct-cut silage was liquid.

ARS dairy husbandman C. H. Gordon and associates were able to keep haylage storage losses lowest when: (1) The silo was free of air leaks; and (2) the silage was capped with high-moisture unwilted forage to retard top spoilage. In fact, spoilage was eliminated the following year when both precautions were observed.

Silage quality apparently is directly related to amount of dry matter in the forage when ensiled.

Low levels of ammonia and of acetic, propionic, and butyric acids—undesirable fermentation end products—are characteristics of high-quality silage. Increasing the dry-matter content of forage (as by wilting haylage) is directly related to reducing these end products. Reasons for this relationship are not known.

Haylage fermentation appears limited

Apparently fermentation of haylage is rather limited. It is characterized more by absence of undesirable fermentation end products than by presence of desirable ones.

Forages compared were from the same field and were cut at the same time. Their initial chemical compositions were almost the same, except for higher percentage of dry matter and less carotene in haylage.

The forages were evaluated in a 120-day Latin-square feeding trial. The ration consisted of a test forage fed free-choice, plus a supplementary 16-percent crude protein grain mixture fed according to production.

Researchers found that haylage exceeded direct-cut silage in feeding value for dairy animals, though haylage was inferior in digestible protein content. Dry matter digestibility was about equal in the two silages. Better acceptance of haylage was its most outstanding advantage from a feeding standpoint.

Lower levels of the undesirable fermentation end products in haylage seem to be directly related to its higher animal acceptability.

Barn-dried hay was most digestible

Neither direct-cut silage nor haylage measured up in digestibility to barn-dried hay cut from the same field. The generally lower digestibility of haylage protein cannot be explained adequately, although it might have resulted from heating of the feed in the silo.

The dairy husbandmen emphasize that air must be adequately controlled in the gastight silo to obtain maximum feeding value of haylage. And if silage heating or visible spoilage occurs in farm silos, dairymen should: (1) Correct leaks in the structure; (2) feed out haylage faster; or (3) store forage having a higher moisture content.

Differences in initial investment, maintenance expense, labor costs, and convenience—as well as dollar value of extra silage saved—should be considered in economic evaluation of gastight and conventional tower silos, the scientists say. ☆☆

Progress in Gaging True Feed Value

■ A new, more accurate way to gage the digestibility of livestock feeds has been devised. This laboratory test uses detergents to dissolve soluble ingredients in a feed sample.

The resulting solution, thought to contain nearly all of a sample's digestible matter, is analyzed for amount of digestible carbohydrates and proteins.

A popular way of estimating the digestible part of a feed has been to measure its indicators of digestibility—such as crude fiber and crude protein. But these don't always reflect actual nutritive value.

The new method was developed by ARS biochemist P. J. Van Soest at USDA's Agricultural Research Center, Beltsville, Md. He believes the method will eventually be used to classify true feed values of all types of roughages and concentrates.

Using such information, farmers and feed manufacturers could formulate more efficient livestock rations.

At present, the new method is useful mainly as an aid to scientists studying animal nutrition. Van Soest believes, however, that it may someday replace conventional analytical methods used by State regulatory agencies to verify the accuracy of information on labels that list the amounts of ingredients in feeds.

Limited studies have been made with cattle fed rations analyzed by the new method. Rates of feed utilization observed among these cattle confirmed the accuracy of the analyses. More extensive studies now in progress will permit more definite conclusions.

Van Soest says the new method is more accurate than a standard analysis, because detergents don't remove lignin from feed samples during evaluation. Lignin is a hard, cellulose-like substance that affects digestibility. Much lignin is removed by conventional analysis, thus altering the value of crude fiber as an indicator of digestibility. Feed samples analyzed by conventional means may appear to have a different rate of digestibility than the feed actually possesses.☆

A New Test for
RATING LIVESTOCK SHADES

■ A rapid, accurate test for rating the heat-reducing properties of materials used to shade livestock from the sun has been devised by USDA and California scientists. This inexpensive test can be conducted during any warm sunny day.

Test shades are supported by open frames 4 feet high. A thermocouple inside a painted copper sphere (black globe thermometer) measures the intensity of heat 18 inches beneath each cover being evaluated. This type of thermometer gages the combined temperature effects of air, solar radiation, and wind.

A check material—embossed corrugated aluminum—is compared with test shades during each experiment so that the aluminum's temperature reading can be converted to a constant factor for comparing shades tested at different times.

Field experiments at Davis, Calif., were devised by ARS agricultural engineers T. E. Bond and LeRoy Hahn, and California Agricultural Experiment Station agricultural engineer C. F. Kelly and animal husbandman W. N. Garrett.

Of 50 shades tested, 25 were found more effective than the check material. Most efficient was a 6-inch layer of hay (AGR. RES. May 1954, p. 11). Painted steel and aluminum surfaces, painted or aluminum foil-covered fiberboard, plastic and plywood surfaces, and neoprene-coated nylon were also very effective.

Less efficient were snow fences (lattices), and translucent polyethylene film coverings.☆

Efficiency of a shade material is measured by instruments placed beneath it. Black globe thermometer on ground gages radiant heat load. Radiometer under frame records radiation on material's underside.

Cotton breeding research may be more efficient because we can evaluate many more samples than before, using a faster

Miniature Spinning Test

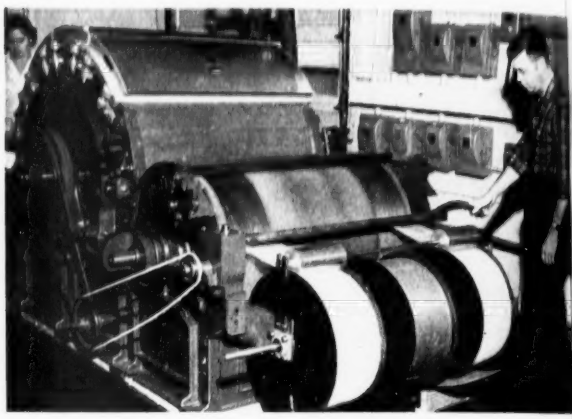
■ A new miniature spinning test for cotton makes it economically feasible to test yarn strength of fiber from large populations of experimental cotton plants. It will be a big help in developing strains and varieties of cotton with improved processing quality.

Only 50 grams (less than 2 ounces) of cotton lint are used in the new test, developed at USDA's Spinning Laboratory at Knoxville, Tenn., in cooperation with the Tennessee Agricultural Experiment Station. The test is made in half the time required for the laboratory's earlier test, which required half a pound of lint.

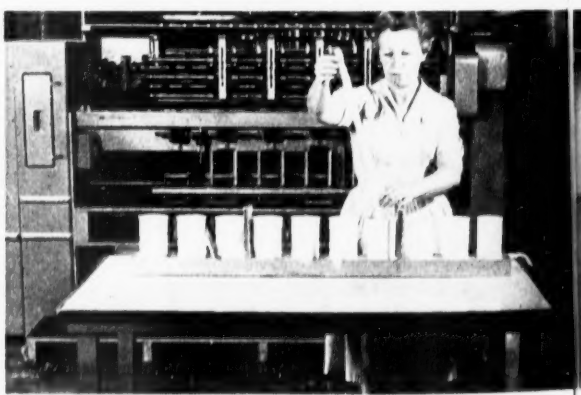
During 3 months last year, ARS scientists at Knoxville used the new method to test 3,000 samples of cotton from varieties and strains entered by public and private breeders in the annual Federal-State yield trials. The researchers believe it should be fairly easy to test 4,000 to 5,000 samples in the same period—the number needed to determine significant variations in cottons of different genetic makeup and from different environmental backgrounds.

Demand for spinning quality evaluations is increasing each year, according to Thomas Kerr, in charge of research on the fiber quality of new cottons being developed in cooperative ARS-State breeding programs. Processors are keenly interested in this research to obtain cottons that will process easily and economically into yarns and fabrics of superior quality.☆

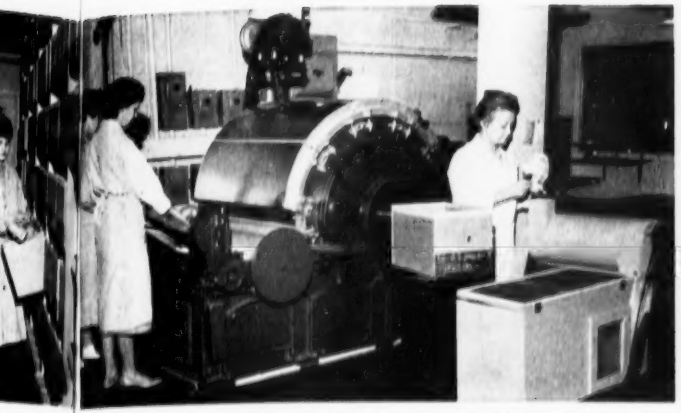
1. Cotton samples, received from breeders, are weighed into 50-gram lots and stored in the mail-type slots until spinning time.



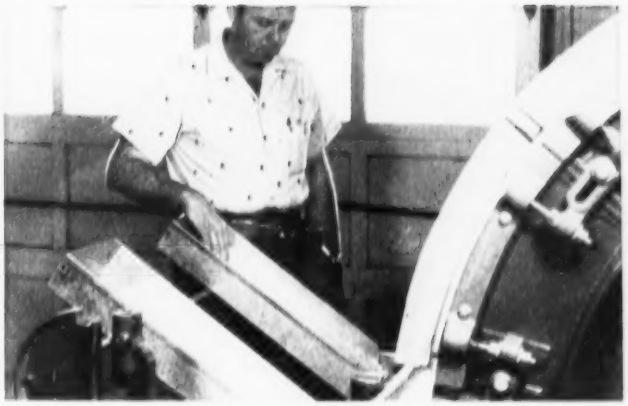
4. After processing, cotton comes off card in form of web. It is collected on revolving drums in successive layers, forming a lap.



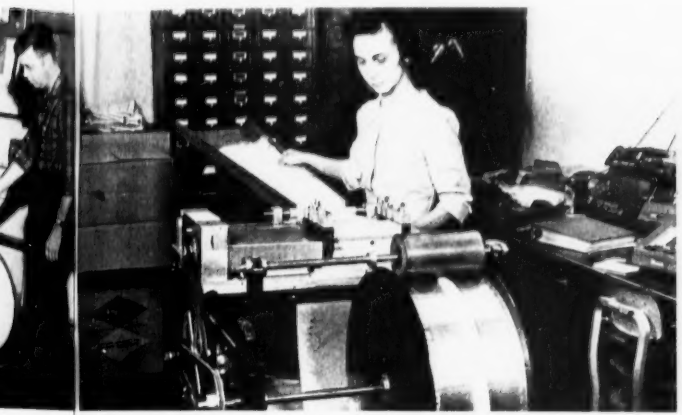
7. Measured lengths of sliver are put in containers, which will then be placed on the special spinning frame (rear).



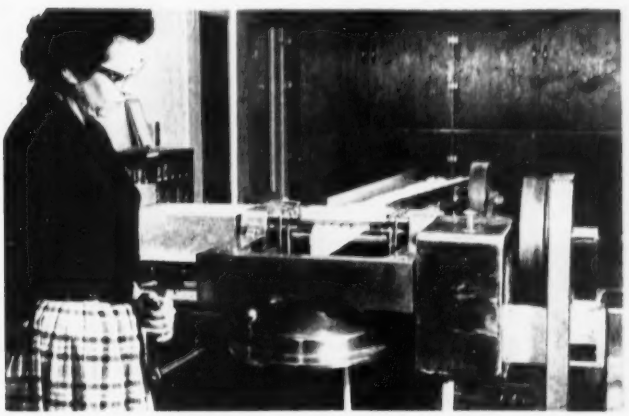
2. A 50-gram sample is taken from labeled box and put into miniature opener (right), where the sample is opened, fluffed before carding (left).



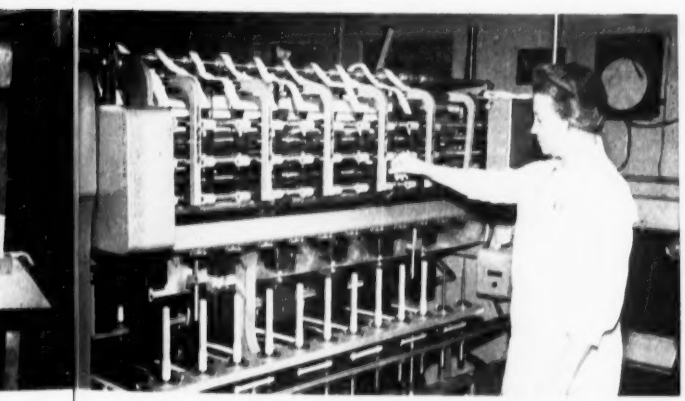
3. Opened cotton sample is placed on tray. The cotton moves under a feed roller and is processed through a granular card.



5. Lap has been removed from the drum and placed on tray. It is drafted through drawing frame in the form of sliver. Three draftings are made.



6. Final drafting forms the finisher drawing sliver. These draftings blend and straighten the cotton fibers to give them uniformity for spinning.



8. Slivers are spun from containers directly into yarn and collected on bobbins. Conventional roving process is omitted in the new test.

9. Yarn is wound into skeins (right), which are tested (left) to determine yarn strength. Test results are then sent to cotton breeders.

NOW DIURON CONTROLS EMERGED WEEDS IN COTTON

It's done by mixing a surfactant with the herbicide

■ Diuron's value for controlling weeds in cotton has been dramatically increased by mixing this herbicide with one of several surfactants.

They alter the herbicide's action (AGR. RES., June 1961, p. 3) so it can control *emerged* weeds. Used alone, diuron won't penetrate leaves to kill weeds. It is effective only for killing them before emergence.

Surfactants increase diuron's absorption by leaves, making it effective as a foliar spray.

This means that an application of a surfactant-diuron mixture to weed foliage may replace the diuron treatment at lay-by (after final cultivation), which many farmers consider necessary. If used, the surfactant-herbicide application will cost less than half as much, and potential residue hazards to subsequent crops will be eliminated.

Field studies show that about 0.5 pound of diuron plus less than 1.5 pounds of surfactant per acre will control growing weeds. This small amount of herbicide won't leave harmful residues. Per-acre cost of this mixture is about $1 to $3.

Lay-by treatment costs about $6 to $8 an acre, requires 1 to 2 pounds of diuron. Herbicide residues sometimes damage crops that follow.

These studies suggest that surfactants may change the way a herbicide can be used to kill weeds.

For example, diuron at 4 pounds per acre was sprayed on a plot of Johnsongrass without visible effect. But 80-percent control of this weed for 6 to 8 weeks was obtained by adding to the herbicide a 0.25-percent concentration of a surfactant (an alkyl polyoxyethylene ether or alkylacrylpolyoxyethylene glycol type).

Addition of improper surfactants, however, may destroy a weedkiller's selectivity and cause injury to crops.

These laboratory and field studies were conducted by ARS plant scientists C. G. McWhorter, T. J. Sheets, and J. T. Holstun, Jr. This USDA research is cooperative with the Mississippi Agricultural Experiment Station, Stoneville.

Studies are now being made to determine ideal diuron-surfactant mixtures, rates, and times of application for controlling emerged weeds in cotton. Recommendations may be available next spring.☆

EFFECTIVE IN SOYBEANS

■ Emerged weeds in soybeans also may be controlled with diuron plus a surfactant. Without a surfactant, diuron will not kill weeds if applied after they emerge.

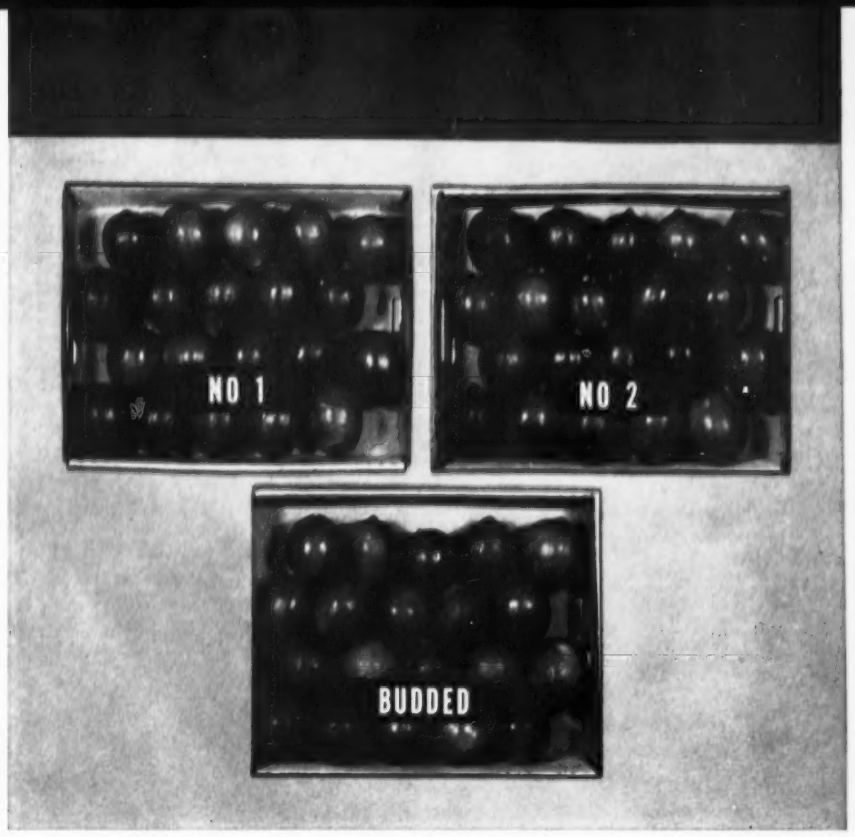
Scientists applied a diuron-surfactant mixture as a directed post-emergence spray for controlling weeds in soybeans. They tried a large number of rates of diuron and various concentrations of surfactants. A mixture of only ¼ pound of diuron plus 1½ pounds of surfactant per acre controlled weeds effectively without injuring the crop.

The surfactant greatly increased diuron's activity on weeds so that a concentration of herbicide, too weak to damage soybeans, could be used.

This was a limited study. More research is necessary to fully determine the effects of herbicide-surfactant mixtures on soybeans.☆

Diuron-surfactant mixture killed emerged weeds in this plot of cotton. Holstun checks sprayed and uncontrolled strips.

McWhorter compares lush weed growth in unsprayed soybeans with weed-free strip treated with diuron plus a surfactant. Surfactant makes a foliar application of diuron effective.



Fruit from the two seedling trees (No. 1, No. 2) and old-line budded trees is identical, and typical of Persian limes.

Our First Disease-Free Persian Limes

Two virus-free trees grown from seed may save industry by giving growers new source of budwood

■ Two Persian lime trees, specially grown from seed, may provide Florida lime producers their first disease-free source of budwood.

Our entire domestic supply of these large seedless limes comes from a few groves in south Florida. Lime trees have been plagued with serious bark and virus diseases ever since commercial production began about 30 years ago. Many plantings are lost before the trees are old enough to produce even one normal crop of fruit. Because the average life of Persian lime trees is shortened by disease, production costs for limes are higher than for other citrus fruits.

About 10 years ago, ARS plant pathologist J. F. L. Childs and associates at USDA's Horticultural Field Laboratory, Orlando, Fla., planted about 250 lime seeds in an attempt to grow virus-free trees. The seeds were obtained in a tedious search through two truckloads of pulp at the Florida Citrus Canners Cooperative. (Only about one seed is found in an 80-pound box of Persian limes.)

Most of the trees that grew from these seeds produced leaves and fruit unlike commercial Persian limes. Some developed symptoms of lime feaf blotch—evidence that this disease can be transmitted through seed.

Two of the trees have shown no evidence of disease. And they are bearing true Persian lime leaves and fruit.

Analysis of fruit from these two seedling trees shows that total soluble solids and acid are slightly higher than in fruit of old-line budded trees. The seedling fruit is slightly smaller and juicier.

In taste tests, using thin lime slices and samples of limeade that all contained the same amount of sugar, a majority of tasters rated the seedling fruit below the less acid budded fruit. When sugar was added to bring all the different juice samples to the same solids-acid ratio, most of the tasters preferred limeade made from fruit of the seedling trees. These tests were conducted by Agricultural Marketing Service physiologist W. G. Long of the Orlando Laboratory.

Samples of fruit from the two seedling trees and from budded trees were sent to cooperating scientists at the French Institute for Fruit Research, Paris, France, for chromatographic comparison of rind oil. These studies showed the rind-oil characteristics of the Florida fruits to be identical and typical of true large-fruited Persian limes.

Plant pathologist Childs plans to enter the new seedling trees as candidates in the Florida Citrus Budwood Certification Program as virus-free sources of Persian lime budwood.☆

Davis examines carrot flowers, encaged with the flies as pollinators, for seed set.

Carrots are halved and selected for internal color, then grown for seed.

Deformed carrots result from injury by root-knot nematode.

What We're Doing To Improve Carrots

The object is to develop breeding stocks with several desirable characteristics

■ Houseflies, blue-bottle flies, and carrot varieties ranging in color from white to purple are among the unusual tools and materials USDA and State scientists are using in the National Carrot Improvement Program.

These researchers are working to develop carrot breeding stocks that resist diseases and nematodes, emerge earlier, and have uniformly high seed set. They are also trying to breed even-colored, nonbitter carrots of suitable sizes and shapes for processing and for sale fresh. They hope ultimately to develop hybrid carrots as a means to improve quality.

White, yellow, red, and purple carrots—ancestors of our conventional orange varieties—are part of the collection of strains being tested for disease and nematode resistance.

The flies are used in the greenhouse as easy-to-handle substitutes for bees, which normally pollinate carrot flowers in the field. This pollinating technique was first used on onions by horticulturist H. A. Jones (retired) and geneticist S. L. Emsweller of ARS.

Early screening tests have uncovered plants with resistance to aster-yellows virus, *Alternaria dauci*, and *Cercospora carotae*, which cause the three main carrot diseases. These leaf diseases plague carrot growers in California, Florida, Michigan, New York, New Jersey, Texas, and Wisconsin. Some plants with resistance to the root-knot nematode have also been found. Resistant selections are being rechecked in field tests.

Basic genetic research, as well as screening, is part of the effort to develop carrots with a uniform orange color all the way through. Carrot cores are generally much lighter than the tissue surrounding them. And in many varieties, green streaks occur in the core and on the shoulders. Researchers must determine how the color factors are inherited and influenced by environment.

Carrots are first screened for shoulder greening in field tests at the U.S.-Colorado Potato Experiment Station, Greeley, Colo. Selected plants are sent to E. W. Davis, leader of ARS carrot investigations. He screens for internal color, and increases seed of desirable strains in the greenhouse at the Agricultural Research Center, Beltsville, Md.

Scientists at several stations are selecting carrots for shape and size. They want large ones for processing, smaller and thinner sizes for fresh market, and finger-size carrots for canning or freezing whole. The latter type can be much tastier than larger carrots.

Photos are taken to show size, shape, and color contrasts of all carrots used in the research at Beltsville. These photo records make it possible to accurately trace the parentage of crosses.

Other work is underway to determine the optimum level of sugar in carrots, and to develop carrots high in carotene, which is valuable as a food color and for vitamin A.

Carrot research is conducted jointly by USDA and State scientists in Maryland, Idaho, Wisconsin, New York, California, Texas, and other States. Carrot processors and seed companies are participating.☆

Experimental machine digs soil and throws it on flame in trees or on the ground

Sandthrower Smothers Forest Fires

■ An experimental machine designed to fight forest fires by smothering them with sand or dirt has been developed by the U.S. Forest Service and Michigan's Forest Fire Experiment Station. Its capabilities are being studied in USDA-State trials.

Called a sandthrower, it is a device that tests show can be used to combat crown fires—those that spread through treetops. Soil cast by the machine also smothers ground fires and retards the combustion of materials in a fire's path.

This unique implement throws sand or dirt a distance of 50 feet or to a height of 25 feet. It delivers 2 to 4 cubic yards per minute in a steady 70-m.p.h. stream. Its operator uses hydraulic controls to change the trajectory and direction of soil being thrown.

The sandthrower operates by digging its own sand or dirt supply. This leaves a shallow trench about 2 feet wide—a valuable fire barrier.

To dig the trench and throw dirt, the machine uses impeller vanes projecting from a 700-pound rotating disk at the rear. Power is supplied by a 130-hp. engine.

Machine will probably be used in areas not too dense

Use of the sandthrower will probably be limited to fire areas that aren't too heavily wooded. It must have room to maneuver.

Also, the soil it uses must be mainly loose dirt or sand. The device can't operate in terrain where it is unable to dig a trench. There must be relatively firm ground, though, to support the sandthrower's weight—6,300 pounds.

Minor changes in the experimental model are being made as the result of recent trials on test fires, conducted by Forest Service and State scientists in Georgia and Michigan. The sandthrower was developed at Michigan's Forest Fire Experiment Station, Roscommon.

The device will soon be made available to firefighters to try against actual forest fires.☆

Towed by a crawler tractor, the sandthrower digs and throws dirt simultaneously. Scientists are planning to develop a similar machine that is self-propelled.

Vanes are attached to rotating disk by shear pins; broken vanes can be replaced in about 2 minutes.

This new technique could be useful if we are attacked with nuclear weapons

STRONTIUM 90 CAN BE REMOVED FROM MILK

Scientist uses balling gun (above) to insert capsule of radioactive strontium in cow's throat. Cow will secrete 1 percent of the element in her milk. Then the milk is passed through columns (below) of ion-exchange resin to remove the strontium.

■ A method for removing strontium 90 from milk has been developed to help assure a safe and palatable milk supply in the event of nuclear attack.

The process was worked out jointly by ARS, Atomic Energy Commission, and U.S. Public Health Service. It is now being tested on a pilot-plant basis at USDA's Agricultural Research Center, Beltsville, Md.

The test equipment is similar to that in a very small milk plant, except that pipes, or columns, containing an ion-exchange resin (chemical beads) have been added. To remove the strontium, cold raw milk is treated with dilute citric acid and passed through the columns. The resin removes about 98 percent of the radioactive element. Action of the resin is similar to that of chemicals used to soften hard water.

After the strontium 90 is removed, the milk is treated with dilute potassium hydroxide (an alkali) to neutralize the acid, then pasteurized and homogenized. Water added with the acid and alkali is removed by flash heating the milk in a vacuum chamber.

These treatments do not noticeably alter flavor. Pure milk run through the experimental pilot plant to standardize the procedure proved as palatable as commercial market milk.

The pilot-plant tests are based on laboratory studies, which showed that ion-exchange resins are effective in removing radioactive strontium from milk containing an increased amount of acid. In these basic studies, scientists charged a resin with calcium, sodium, potassium, and magnesium—the major metals in milk.

Milk, experimentally contaminated with radioactive strontium, was passed through columns containing this resin. Free (ionized) strontium moved from the milk and displaced the ionized metals on the resin. This ion-exchange occurs because the resin attracts strontium more strongly than it attracts the other metals.

Since only about 60 percent of strontium in milk occurs in ionized form, citric acid was added to the milk to ionize the rest of the radioactive element. This enabled the resin to attract and remove 98 percent of the strontium from the milk.

Other research has shown that only a small portion of strontium 90 in fallout is absorbed by plants. Dairy cows eating these plants take about 5 percent of the strontium into their systems and secrete about 1 percent of it in their milk. Removal of 98 percent of such a tiny amount of strontium would make milk one of our safest foods during emergencies.

These cooperative studies will continue until a process is developed that can be operated continuously and economically in milk plants.

AGRISEARCH NOTES

Canned wheat is convenience food

A new convenience food, ready-prepared canned whole-grain wheat, has been developed by ARS Utilization Division scientists at Albany, Calif.

This product can be used to enhance vegetable soups, stuffed peppers, curried lamb pilaf, stuffing for roast chicken, Swedish meat balls, tossed salad, Indian pudding, and pineapple Bavarian.

The new food is being test-marketed by USDA's Agricultural Marketing Service in cooperation with the Kansas Wheat Commission.

Only a few minutes' heating in a little water is needed before serving this wheat product. It consists of cooked whole grains of wheat, with only the rough outer layers of bran removed. It has a delicate whole-wheat flavor and essentially the same nutritive value as whole wheat.

Better way to analyze phosphorus

A new method for measuring usable phosphorus (that available to plants) in fertilizers permits faster, money-saving analyses by State laboratories testing fertilizers for label accuracy.

The method involves direct determination of usable phosphorus—soluble in water or ammonium citrate—instead of the conventional indirect determination.

Using the new procedure, chemists filter water-soluble phosphorus out of a fertilizer sample. The remainder is digested in ammonium citrate for 1 hour at 65° C. This citrate-soluble phosphorus is then filtered out of the sample.

Phosphorus in the combined filtrate (containing the two types of soluble phosphorus) is measured volumetrically or spectrophotometrically.

The indirect way of gaging usable phosphorus is to determine total phosphorus, then insoluble phosphorus, and subtract to find how much is soluble. This is time-consuming.

Development of this direct method of determination was led by ARS chemist W. M. Hoffman, U.S. Fertilizer Laboratory, Beltsville, Md. Hoffman is in charge of research on methods of analysis for phosphorus in fertilizers for the Association of Official Agricultural Chemists.

The new process is being tried by several laboratories this year. Missouri chemists say the technique allows them to reduce by $10,000 the yearly cost of analyzing fertilizer samples.

Another State official reported that in his laboratory two technicians, using the direct procedure, can analyze 100 samples as quickly and accurately as three technicians could analyze 30 using the indirect method.

Aid for studying bean mosaic virus

A valuable tool for research on the common bean mosaic virus (CBMV)—a method for producing countable local lesions in plant leaves—has been developed by USDA scientists.

The method consists of detaching leaves from CBMV-inoculated plants and incubating them in the dark for 72 hours at 32° to 35° C. The leaves, from Tenderlong 15 or Topcrop bean plants, are placed in petri dishes on 1-percent agar medium containing 8-percent glucose or sucrose. This treatment causes appearance of isolated, small lesions or dead areas, instead of the general mosaic pattern normally caused by CBMV in some bean varieties.

Researchers use comparative numbers of virus-caused local lesions to determine the relative amount of virus in infected plants or plant parts. Local lesion formation permits study of relative virus multiplication or inactivation—for example, in experiments on chemical control of viruses. Plant breeders also use local lesions to determine the degree of resistance of a variety to a virus.

ARS plant pathologists I. R. Schneider and J. F. Worley developed the method of producing local lesions with CBMV at the Agricultural Research Center, Beltsville, Md. Their method is a modification of an earlier technique, which produced extensive veinal necrosis in leaves of certain bean plants, but did not permit measurement of virus content.

Story of seed is yearbook theme

The story of seeds is the story of agricultural progress in the U.S. This is the theme of *Seeds*, 1961 Yearbook of Agriculture, recently published by USDA.

Seeds describes the vast improvements that have been made in the production, processing, marketing, and utilization of seeds—improvements that make it possible for our increasing population to enjoy a bountiful and continuing supply of food and other farm products.

The 1961 yearbook is the latest in a series that dates back to 1849, when the Commissioner of Patents pre-

UNITED STATES GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS, WASHINGTON 25, D.C.

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE TO AVOID PAYMENT OF POSTAGE, $300 (GPO)

pared the first annual report of his agency's work in agriculture.

Seeds contains 75 chapters and 48 pages of photographs, contributed by 128 scientists and technicians of USDA, State universities and agricultural experiment stations, and the seed industry. Topics discussed include the history and life processes of seeds, introduction and improvement of seeds for cropland, forests, and ornamental plantings, how seeds are produced, processed, and marketed, and economic trends in seed production and utilization.

The yearbook is written for farmers, gardeners, seedsmen, students, and others interested in the production of high-yielding, high-quality seeds and crops.

Seeds is available for $2 from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Moving against the fire ant

We're making progress against fire ant infestations in nine Southern States.

Plant pest control workers have prevented long-distance spread of the ant and eradicated infestations on nearly 3 million acres.

Treatment of infested acres with low dosages of heptachlor (two applications of ¼ pound per acre, 3 to 6 months apart) is over 99 percent effective and not hazardous to wildlife. ARS scientists at USDA's Methods Development Laboratory, Gulfport, Miss., (AGR. RES., June 1959, p. 6) devised the treatment. University of Georgia specialists tested its effect on wildlife.

The imported fire ant has been almost eliminated from Arkansas, North Carolina, and South Carolina, and from 75 counties on the edges of infested areas in Alabama, Florida, Georgia, Mississippi, and Texas. Major infestations remain in the latter five States and Louisiana.

Efforts against this pest are continuing through quarantines and, where funds are available, insecticide treatment. Property owners and county and State officials cooperate.

Hard, crusted mounds of the fire ant cause damage to farm machinery and reduce carrying capacity of pastures. The ant also makes hand-harvesting hazardous and damages crops.

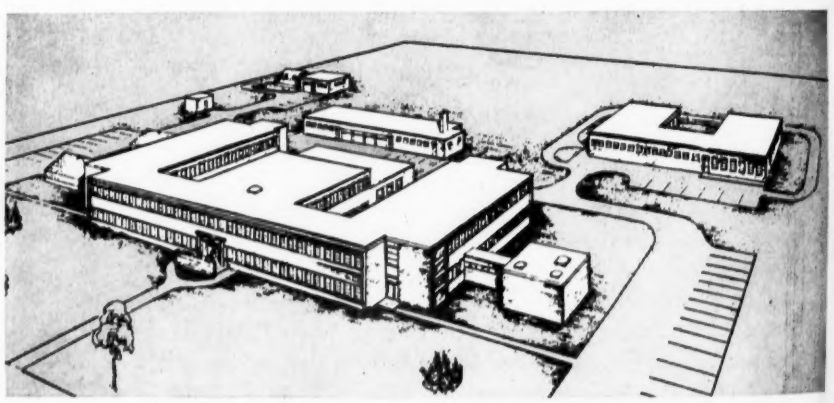
New USDA laboratory at Fargo

A new laboratory will be constructed for expanded USDA research on chemicals that influence insect, animal, and plant metabolism.

Fargo, N. Dak., is the site of the $2 million two-story facility. Construction is expected to be completed by September 1963. North Dakota Agricultural College donated the 10-acre site. Land for livestock will be leased from the college.

ARS entomologists, animal husbandmen, and agronomists will study how chemicals move through and affect insects, plants, and animals and what effects the living systems have on the chemicals.

Radioactive cobalt and X-rays will be used to modify hereditary characteristics of insects, and radioactive isotopes will be used to trace the path of test chemicals.



Insects, animals, and plants will be test subjects at our new Metabolism and Radiation Laboratory.

U.S. GOVERNMENT PRINTING OFFICE: 1961